Injuries in men's elite handball

A review of the literature

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Abstract

Background:

Several authors have analyzed the incidence of injuries in team handball, but there is a lack of knowledge concerning professional handball and especially for men. The aim of this study is to review the literature and analyze the incidence, circumstances and characteristics of handball injuries in men's elite handball.

Methods:

A systematic search in PubMed is used. In general only results from men's elite handball are included, but a few exceptions are made when it comes to studies where the results are not separated between the different groups. When comparing studies one must be aware that the definition of an injury might differ.

Results:

The highest incidence of injuries is reported in major international tournaments with 1.2-2.7 injuries/match and 89-129 injuries/1000 match hours. ACL injuries specifically have an incidence of 0.24±0.09 injuries/1000 match hours. About 40% of all injuries that need medical treatment are caused by overuse and the most common locations are the shoulder and knee. Some studies have showed that up to 30% of all injuries were classified as major with a time loss over 28 days.

Discussion:

There is a larger risk of sustaining an injury during matches than training and there are more injuries as the performance level increases. However, more research is needed in elite male handball and especially concerning overuse injuries and injuries to the head. With sufficient information about the total burden, injury types and mechanisms, it has been shown that prevention programs based on this information can reduce the injury incidence.

Table of Contents

Introduction

Team Handball is a popular sport in Europe and it has been an Olympic sport since the Olympic Games in Münich in 1972. Today, handball is a sport played in 183 countries; there are 19 million players worldwide and 795,000 teams (International Handball Federation 2009).

Handball has since the beginning been a game in continuous development. There has been an increase in the players' speed, strength and technique, and changes in the rules and tactics. This along with excitement until the very end of each game have made handball into a sport of great public interest. The Men's EHF European Championship 2008 in Norway had about 1.2 billion television viewers and it was broadcasted in 85 nations (European Handball Federation).

In elite handball it takes few seconds from a team has lost control of the ball till the opponent makes a counterattack. Despite this, many teams substitute one or two players between attack and defense. Some players are specialists in offense and others in defense. Handball is a game with much contact between the players and it is common that teams play hard and destructive to achieve advantages. If the use of a tackling can make the attacker a little reserved, the defense player has won a small victory. The referee has an important task taking care of the player's health by keeping the game fair and sanction brutal play.

Earlier studies in the handball literature have reported that injuries caused by a contact situation represent between 40% and 84% of the total number of injuries (Nielsen and Yde 1988; Fagerli et al.1990; Langevoort et al 2007).

Matches are played all year round when it comes to a professional level. The best players, which have activity with a national team and participate in an international tournament with their club, play between 70 and 100 matches a year. Each year there is either a World Championship or an European Championship played and every fourth year there is also a handball tournament in the Olympic Games. The burden at each player varies depending on personal level and the total number of players in the teams, but it is in general high and there is especially short time to rest during a championship where the best teams play 8 matches in 13 days (European Championship 2010).

The purpose of this study is to review the literature of elite handball for men, presenting injury incidences, prevalence, injury types and locations and to see what kind of studies that are needed in the future.

Materials and Methods

This article is based on a systematic search in PubMed.

Key words: handball, handball injuries, elite handball, jumpers knee, ACL injuries, shoulder injures and goalies elbow.

The literature consists of many studies on handball, but there is a lack of knowledge concerning men's handball and especially in the elite level.

Some research have been performed looking at injuries at the top international level for men in the Olympic Games in Athens 2004 (Junge et al. 2006) and the World Championships in 2001 and 2003 (Langevoort et al. 2007).

Gundersen and Myklebust have done a prospective study examining Norwegian elite handball during the season 2008/2009. This is not published yet, but the abstract is available. Furthermore Asembo and Wekesa did a study under East and Central Africa Senior Clubs Championship in Kenya in 1995 and Oehlert et al made a video analysis of injuries during the Olympic games in Barcelona 1992.

In the already mentioned literature, these studies are at the highest performance level, however, there are published more studies in handball. Some of these studies include both genders while other includes both elite and amateur teams. A challenge here is that the authors not always present the data separated, which makes it difficult to analyze for this purpose. (Jørgensen 1983 and 1984, Leidinger 1990).

Since the numbers of studies in elite handball for men are limited, parts of other studies are included in this paper. (Tyrdal & Bahr 1996, Seil et al 1998)

One methodological problem in the handball literature is that the definition of an injury differs. Most studies in elite handball define an injury as "any physical complaint incurred during the match that received medical attention from the team physician regardless of the consequences with respect to absence from the match or training" (Langevoort, Junge, Gundersen). Another common definition is where an injury is causing time loss from match or practice session (Tyrdal & Bahr, Nielsen & Yde). A third definition is "all injuries which led either to a temporary stoppage of the game or to substitution of the injured player" (Asembo & Wekesa and Oehlert).

Similar to the challenges in the injury definition, there are differences in the definition of the injury's severity. The most used classification in the handball literature is: minor injury (1-7 days absence), moderate injury (8-21 days absence) and major injury (>21 days), but these studies do not include injuries without time loss. At the same time there is a weakness in some studies (i.e. Langevoort et al and Junge et al), where the duration of absence is estimated at time of injury and not by following the player in the rehabilitation phase to give the exact time frame.

Results

Who is affected by an injury?

Langevoort et al have done a study (1) analyzing injuries in major international tournaments, including the men's World Championships in 2001 and 2003. In the World Cup 2001 in France 80 matches were played and Langevoort et al found an incidence of 110 injuries/ 1000 match hours and 1.5 injuries / match. If we just look on the time loss injuries it gives an incidence of 31 injuries/1000 match hours and 0.4 injuries/match.

At the following World Cup in Portugal the incidence was 129 injuries /1000 match hours and 1.8 injuries/match. Injuries that led to time loss were 34 injuries/ 1000 match hours and 0.5 injuries/match.

Junge et al did a similar study (2) at the Olympic Games 2004 in Athens. In the men's tournament the results were 89 injuries/1000 match hours and 1.2 injuries/match. The numbers of time loss injuries were 40 injuries/1000 match hours and 0.6 injuries/match.

Asembo and Wekesa found in their study (4) from Kenya in 1995 under East and Central Africa Senior Clubs Championship, an average incidence of 2.74 injuries/match. They also found an incidence of 0.9 injuries/player during the 19 matches the championship lasted.

Tournament	WC 2001	WC 2003	OG 2004	Kenya 1995
No. of matches	80	80	44	19
Respons rate	125 (78%)	122 (76%)	79 (90%)	
No.of injuries	96	110	49	52
Injuries/1000 h	110	129	89	
Injuries per match	1.5	1.8	1.2	2.74
Time loss injuries	27	29	22	
Injuries/1000h	31	34	40	
Injuries per match	0.4	0.5	0.6	

Gundersen and Myklebust have in a prospective study (3) in Norwegian elite handball registered injuries in the season 2008/2009. All acute and overuse injuries that needed medical attention and/or led to absence from match or training were registered. In total they found an incidence of 3.9 injuries/1000 match hours. Acute injuries were 1 injury /1000 training hours and 15.2 injuries/1000 match hours. There are in other words a 15 times higher risk of getting injured during match than training.

Leidinger et al did a study (5) among German senior players where they analyzed injuries that needed medical attention and occurred during a five years period in 1981-86. They found that 96% of the players at the highest performance level (Bundesliga) got injured each year.

ACL injuries

Several studies have reported the incidence of ACL injuries in team handball.

Strand et al (1990) did a retrospective study (6) in a specific part of Norway covering ten seasons from 1979-89 and found an incidence at the top three divisions in Hordaland handball area to be 0.31 ACL injuries/1000 match hours.

Myklebust et al 1997 (7) registered all cruciate ligament injuries during the seasons 1989-90 and 1990-91 in Norwegian elite handball. At the highest performance level for men the incidence was 0.54 injuries/1000 match hours and 2.2% of the players suffered an ACL injury per season. On the second highest level there was 0.84 injuries/1000 match hours and 2.0% of the players suffered an ACL

Myklebust et al. 1998 did a prospective study (8) of ACL injuries in Norwegian elite team handball covering the seasons 93/94, 94/95 and 95/96. In this period a total of 5 ACL injuries occurred among men and the incidence was calculated to be 0.06±0.03 injuries /1000 hour. During competition the incidence was 0.23±0.13 injuries/1000 match hours. In this study there was a 5 fold higher risk among woman than men.

The reason for the marked gender difference is unknown, but several hypotheses have been suggested, both intrinsic (anatomic, strength, coordination, hormonal, level of skill and conditioning) and extrinsic (shoe and surface type).

Olsen et al (2003) based their study (9) on injury data collected as part of three previous studies (Myklebust et al., 1997, 1998, 2003). ACL injuries have prospectively been registered for 7 seasons in the period 1989-00. During this time 9 ACL injuries occurred during regular league matches for men. This gives an incidence of 0.24±0.09 injuries/1000 match hours.

Overuse injuries

Knowledge of overuse injuries in elite handball is sparse, but a study by Gundersen and Myklebust (3) showed that 41% of all injuries that needed treatment were caused by overuse. The most common location to have an overuse injury, according to this study, was the shoulder (n=50, 22%). This study does not divide the overuse injuries by gender.

This high number of overuse injuries in the shoulder are also found in a German study (10) by Gohlke, which reported that 40% of 25 male handball players had been debilitated during handball activity in the last 6 months caused by shoulder pain.

The high prevalence of overuse injuries in the shoulders are also confirmed by Nielsen and Yde (11) where 8 out of 12 injuries located to shoulder and elbow were overuse injuries incurred during practice. The same study reported that 27% of all injuries were overuse injuries.

In the study by Leidinger et al (5), 68.5% of the handball players complained about injuries. The most common locations were knee (26.9) and ankle (20.3%), but handball specific injuries like “throwing shoulder” and “throwing elbow” accounted for 17.1% and 11.9% of the overuse injuries.

A study by Tyrdal and Bahr (12) looked at the prevalence of elbow problems among goalkeepers, 41% of 729 goalkeepers in the top 4 divisions for both gender experienced elbow problems. This condition is called goalies elbow because of the repeating hyperextensions causing the injuries. Only 63% of the clubs responded the invitation to the study and this is a weakness of the study.

These numbers are matching what Seil et al 1998 found in their study (13) at a superior nonprofessional level, where one out of three goalkeepers suffered from overuse symptoms from the elbow. In addition 17% of the players with overuse symptoms were complaining about symptoms from the low back.

There has been research on other specific injuries as well. Lian et al (14) researched jumpers knee among elite athletes from different sports. The total prevalence among male players was 30% and out of them did 13.5% have current symptoms.

Injury type

In international championships (Langevoort et al and Asembo & Wekesa) contusions are the most common injury type with between 44-60%, followed by sprains with 7-27% of all injuries. In other studies like Seil et al 1998 and Nielsen & Yde sprains are the most common injury type with 46-68%. This might be a result of different injury definitions in the studies. In the last two studies in contrast to the first, it was necessary with a time loss for an injury to be included.

Anatomical location

Lower Extremity

Injuries to the lower extremities are common. Merging the numbers from the three championships for men that Langevoort et al studied, the percentage is 43%. 14 % are injuries to the knee, while 11 % are affecting the ankle. Leidinger et al report similar numbers where 46% of all injuries were seated in the lower extremities, and 21% and 12% were located to the ankle and knee. The studies of Jørgensen 1984 and Nielsen and Yde 1988 also confirm these numbers while Gundersen and Myklebust found that there were most injuries to the knee (22%). The last study does not separate between genders when presenting the most common location of injury.

Upper Extremity

Injuries to the upper extremity represent 20% of all injuries according to the studies of Langevoort et al. A percentage at 35 was reported in Leidinger et al, while it was 38% at the regional league in Seil et al 1998 and 41% in Nielsen and Yde. Finger and shoulder injuries are the most common injuries according to these studies.

Head and Neck

A high number of injuries to the head and neck are observed in international championships. The highest rate is reported in the study of Asembo and Wekesa from Africa where 29 out of 52 injuries affected the head. This gives us a percentage of 56.

In Langevoort et al the numbers from the World Cup 2003 and the Olympic games in 2004 (28% and 32%) are similar to what Asembo and Wekesa found. Also the study (15) by Oehlert et al (2004) confirms these percentages (34%). It is interesting like Myklebust discuss in her chapter about team handball epidemiology (16), that there seems to be few concussions among these injuries and that most of these injuries might be blows to the face, nose or possible damage to the teeth. Only 2 out of 52 injuries in the study by Asembo & Wekesa

were concussions while 31 were contusions. This may be influenced by the definition of an injury where events leading to stoppage of the game are included and where a requirement of time loss does not exist. A study by Lieger and von Arx (17) about orofacial/cerebral injuries among professional athletes in Switzerland reported that 4 out of 73 handball players used mouth guards, and the most common injuries were a soft tissue lesion (40%) and a tooth fracture (35%). Cerebral concussions represent 8% of the injuries among handball players without mouth guard.

Time loss

Gundersen reported in the Norwegian prospective study that 30% of injuries were major with a time loss over 28 days. This high number of major injuries is also found in the study by Nielsen & Yde (20% of the injuries). Both these rates are not specific for male athletes.

In the studies by Langevoort et al the estimated duration of absence over 4 weeks where between 1-6 %, but as mentioned previously, injured players in this study were not followed in the rehabilitation. The same study had an estimated duration of absence at 0 days in 50% and 72%. Langevoort et al also found that significantly more non-contact injuries than contact injuries were expected to result in absence from play, and ankle sprain was the most frequent diagnosis of a time loss injury.

What are the inciting events?

Most injuries in elite handball occur in a contact situation. Studies at the highest competition level (Langevoort et al, Oehlert et al and Asembo & Wekesa) found contact injuries to represent between 80% and 92%. About 50% of the injuries during major international tournaments were caused by a foul and sanctioned.

These high numbers are not the case when we examine ACL injuries. They mostly occur in a non-contact situation when the player is doing a plant and cut or a landing after a jump shot (Myklebust et al 1997,1998,2003)

When we take a look at where on the court an injury happen, between 52% and 86% of injuries occur in offense (Leidinger, Seil et al 1997 (18), Asembo & Wekesa and Oehlert).

Osteoarthritis

Osteoarthritis (OA) is a possible consequence both after an injury and long-term elite handball. A study by L'Hermette et al. (19) showed that 60% of retired elite male handball players were diagnosed with premature hip OA in at least one of the hip, compared with 13% of the control suspects.

Protective Equipments

Many athletes use protective equipments to avoid injuries and hard impact on the joints. According to the study of Seil et al 1998 nearly 90% of high-level players wore some kind of protective equipment. This is the use of tape, ankle support, mouth guard, knee/elbow pads and other orthosis, and we understand that protective equipments are part of a handball player's day life.

Discussion

Several problems are related to epidemiologic studies of sports related injuries. The definition of an injury varies and to compare studies with different designs is difficult.

We know from the literature that there is a larger risk of injuries during matches than training (Nielsen and Yde 1988; Seil et al 1998; Gundersen and Myklebust 2009) and a higher injury incidence along with a higher performance level (Langevoort et al, Asembo & Wekesa, Myklebust (16)).

The studies from the international championships for male players showed an incidence of 1.2-2.74 injuries / match. This is about the same as the incidence for women in the European Championship 2002, World Cup 2003 and the Olympic in 2004 (Langevoort et al 2007) but how is the incidence compared with football?

Ekstrand et al did a study (20) in professional football called the UEFA injury study. They found an incidence of 27.5 injuries / 1000 match hour. This is less than Langevoort et al reported (89-129 injuries / 1000 match hour) from international handball, but more than Gundersen & Myklebust (15.2 injuries / 1000 match hour) found in Norwegian club handball.

The study by Junge et al examined not only handball during the Olympics in 2004, but also sports like football, basketball and volleyball. The same study design was used for the various sports making it easier to compare. The injury incidence during the 32 matches played in men's football was 2.4 injuries per match, 109 (85-133) injuries per 1000 player matches and 73 (57-89) per 1000 playing hours. This shows more injuries per match, but overall about the same as in handball. The incidence from basketball and volleyball was lower than for handball and football. However, when comparing the incidences it is difficult because the actual playing time is hard to determine. Unlike football, the match clock stops when the ball is out of bounds in basketball whereas the time of a match is not defined in volleyball. Despite of this methodological dilemma we can still provide a certain impression.

The prevalence of jumpers knee in men's elite handball was according to the study of Lian et al 30% of which 13.5% had current symptoms. The overall prevalence of jumper's knee in this study was 14% across the sports included, with an additional 8% of the athletes reporting previous symptoms. Volleyball- and basketball players were most affected with up to 45% with current symptoms. The prevalence of current jumper's knee was 5.6% in women's handball. The study suggests that jumper's knee is twice as common among male athletes as it is among female athletes.

The studies by Langevoort et al from major international male championships estimated the duration of absence at 0 days to be between 50% and 72%. This might be a result of the injury definition where even minor complaints that received medical attention were included or it might tell us that players are pushing the limit and keep playing matches under a championship in spite of an injury. This can lead to a longer absence after the tournament or a longer time frame with complaints. The players are professionals and therefore have to be

paid by their clubs regardless of whether they play or not. Injuries sustained in national team competitions and the resulting absence not only involve the players, but also give a financial loss for the clubs of the players affected.

An international elite team has in average 6-10 hours of weekly training with just handball. Other physical training and about two matches a week adds to this. Let us see what a team can expect of injuries through a season with some of the numbers reported. Roughly there will be about 300 hours of handball training and 80 matches a year. 80 matches gives 560 hour of exposure per team and with the incidence of 0.54 ACL injuries/1000 match hours found at the highest performance level in Myklebust et al 1997, it gives 0.3 ACL injuries in matches pr team a year.

If we use an injury incidence about 100 injuries/1000 match hours like Langevoort et al., this lead to 56 injuries in matches pr team a year. With a rate like Gundersen & Myklebust reported, a team can expect 8.5 injuries per season.

The high incidence of acute injuries and prevalence of overuse injuries, combined with up to one hundred matches per year for the best players, demands the teams to have a good medical team. Since there is little time to rest it is important that the players get good and necessary help from a physician and physical therapist so they can perform at a maximum level. With activity all year round it is also important that there is a good collaboration between national teams and club teams, so the health of the players are taken care of and not driven to exhaustion. It is interesting to see if the increase from 14 to 16 players in each team in international matches (a rule change introduced before the season 2009/10) will reduce the incidence of injuries.

There is a need of more studies in elite handball for men. Many of the studies in handball are old, retrospective studies with self-report of injuries and when we think of the development of the game, increase in training and number of matches; one might assume that things have changed. These new studies should have a strict and well defined injury definition and register all injuries during an entire season including the preseason.

Research regarding overuse injuries is especially limited. Overuse injuries are a problem for the continuity of training and they reduce the performance. More knowledge on the injury mechanisms is also needed so we can introduce the most effective prevention measures.

More studies are also needed to confirm the high incidence of head injuries and what the consequences are. Is it necessary to have tougher sanctions from the referees when it comes to dangerous play? About 50% of the injuries during major international tournaments were caused by a foul and sanctioned. This stresses the importance of Fair Play as an essential aspect in the prevention of injury.

And might it be an idea to reduce the frequency of international championships from today, with a championship every year to be like it is in football with a championship just every second year? Or is it possible to have more rest days at major events? This would give the best players better time to recover and could reduce the number of injuries and improve the

performance on the court. Injuries are part of an athlete's daily life and with help of sufficient information about the total burden, injury types and mechanisms, we can make better seasonal setup in terms of matches and championships and introduce effective preventive exercises for the purpose of reducing the injuries to a minimum.

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Appendix

Asembo & Wekesa, Langevoort et al.

	Asembo & Wekesa	Langevoort et al.			
Study	**East Africa 1995**	**World Cup 01**	**World Cup 03**	**Olympics Games 04**	**Merged**
No.of injuries	52	96	110	49	255
Injuried body part					
Head, neck	29 (56)	11(11)	30(28)	15(32)	56(22)
Trunk	13 (25)	16(17)	14(13)	5(11)	35(14)
Upper extremities	3(6)	21(22)	21(19)	10(21)	52(20)
Shoulder		4(4)	3(3)	4(9)	11(4)
Arm		2(2)	2(2)	2(4)	6(2)
Elbow		7(7)	6(6)	0	13(5)
Hand incl. Wrist,finger		8(8)	10(9)	4(9)	22(9)
Lower extremities	8(15)	48(50)	45(41)	22(45)	115(45)
Hip, groin		4(4)	3(3)	2(4)	9(4)
Thigh		7(7)	8(7)	2(4)	17(7)
Knee		15(16)	15(14)	5(11)	35(14)
Lower leg		13(14)	1(1)	3(6)	17(7)
Ankle		7(7)	14(13	7(15)	28(11)
Foot/toe		2(2)	3(3)	1(2)	6(2)
Missing		0	1	2	3

	Asembo & Wekesa	Langevoort et al.			
	East Africa 1995	**World Cup 01**	**World Cup 03**	**Olympics Games 04**	**Merged**
Type of injury					
Concussion	2(4)	1(1)	4(4)	1(2)	6(2)
Fracture		1(1)	1(1)	2(4)	4(2)
Dislocation		3(3)	2(2)	2(4)	7(3)
Tendon/ligamentous, rupture, meniscus lesion		4(4)	3(3)	5(11)	12(5)
Sprain	5(10)	10(11)	29(27)	3(7)	42(16)
Strain/mucle fiber rupture		7(8)	7(6)	2(4)	16(6)
Cuntusion	31(60)	57(60)	48(44)	25(54)	130(51)
Tendonitis/bursitis		2(2)	0	0	2(1)
Laceration/abrasion/blister	7(13)	1(1)	7(6)	1(2)	9(4)
Other	7(13)	5(6)	7(6)	5(11)	17(7)
Missing		5	2	3	10(4)